WHAT IS CLAIMED IS:

1. A method for isolating and maintaining a cell from a mixed population of uncultivated cells comprising:

(a) encapsulating in a microenvironment at least a single cell from the mixed population;

(b) placing the encapsulated cell in a growth column; and

(c) incubating the encapsulated cell in the growth column under conditions allowing the encapsulated cell to survive and be maintained, thereby isolating and maintaining the cell.

2. The method of claim 1, wherein the mixed population of uncultivated cells comprises an environmental sample.

3. The method of claim 2, wherein the environmental sample is selected from the group consisting of: geothermal fields, hydrothermal fields, acidic soils, sulfotara mud pots, boiling mud pots, pools, hot-springs, geysers, marine actinomycetes, metazoan, endosymionts, ectosymbionts, tropical soil, temperate soil, arid soil, compost piles, manure piles, marine sediments, freshwater sediments, water concentrates, hypersaline sea ice, super-cooled sea ice, arctic tundra, Sargosso sea, open ocean pelagic, marine snow, microbial mats, whale falls, springs, hydrothermal vents, insect and nematode gut microbial communities, plant endophytes, epiphytic water samples, industrial sites and *ex situ* enrichments.

4. The method of claim 2, wherein the environmental sample is selected from the group consisting of: eukaryotes, prokaryotes, myxobacteria (epothilone), air, water, sediment, soil and rock.

5. The method of claim 1, wherein the mixed population of uncultivated cells comprises a mixture of materials.

6. The method of claim 5, wherein the mixture of materials comprises a biological sample, soil or sludge.

7. The method of claim 6, wherein the biological sample comprises a plant sample, a food sample, a gut sample, a salivary sample, a blood sample, a sweat sample, a urine sample, a spinal fluid sample, a tissue sample, a vaginal swab, a stool sample, an amniotic fluid sample or a buccal mouthwash sample.

8. The method of claim 1, wherein a cell comprises a microorganism.

9. The method of claim 8, wherein the microorganism comprises a bacterial cell, a yeast cell, an archaeal cell, a plant cell, a mammalian cell, an insect cell or a protozoan cell.

10. The method of claim 1, wherein the cells comprise extremophiles.

11. The method of claim 10, wherein the extremophiles are selected from the group consisting of hyperthermophiles, psychrophiles, halophiles, psychrotrophs, alkalophiles, and acidophiles.

12. The method of claim 1, wherein the cells are encapsulated in a porous gel microdroplet (GMD).

13. The method of claim 12, wherein the porous gel microdroplet (GMD) comprises a hydrogel matrix or a selectively permeable membrane.

14. The method of claim 12, wherein the porous gel microdroplet (GMD) comprises a CELMIX™ emulsion matrix or a CELGEL™ encapsulation matrix.

15. The method of claim 1, wherein one cell is encapsulated in each porous gel microdroplet (GMD).

16. The method of claim 1, wherein one to four cells is encapsulated in each porous gel microdroplet (GMD).

17. The method of claim 1, wherein the growth column comprises a capillary.

18. The method of claim 17, wherein the capillary comprises a capillary array.

19. The method of claim 18, wherein the capillary array comprises a GIGAMATRIX™.

20. The method of claim 1, wherein the growth column comprises a chromatography column.

21. The method of claim 1, wherein conditions allowing the encapsulated cell to survive and be maintained comprise providing nutrients at *in situ* concentrations.

22. The method of claim 1, wherein conditions allowing the encapsulated cell to survive and be maintained comprise flowing an aqueous nutrient mixture through the growth column.

23. The method of claim 1, further comprising incubating and culturing the encapsulated cell in the growth column under conditions allowing growth or proliferation of the cells into a microcolony comprising at least two daughter cells.

24. The method of claim 23, wherein the microcolony comprises between about 4 and 100 cells.

25. The method of claim 23, further comprising isolating a gel microdroplet.

26. The method of claim 25, comprising isolating a microcolony from the gel microdroplet.

27. The method of claim 26, wherein comprising isolating a cell from the microcolony.

28. The method of claim 25, wherein isolating a gel microdroplet comprises sorting an encapsulated microcolony by size.

29. The method of claim 28, wherein sorting an encapsulated microcolony by size comprises using flow cytometry.

30. The method of claim 25, wherein the gel microdroplet is isolated by FACS.

31. The method of claim 27, further comprising maintaining the isolated cell by re-encapsulating and re-culturing the isolated cell.

32. The method of claim 31, wherein between about 20 and 100 cells are maintained in each re-encapsulated microcolony.

33. The method of claim 31, further comprising screening the interactions between encapsulated cells.

34. The method of claim 25, further comprising re-culturing the isolated gel microdroplet under the same or different conditions.

35. The method of claim 1, further comprising direct amplification of nucleic acid from the encapsulated cell.

36. The method of claim 23, further comprising direct amplification of nucleic acid from the cultivated encapsulated cells.

37. A method for identifying a polynucleotide encoding an activity of interest comprising

(a) encapsulating in a microenvironment at least a single cell from the mixed population;

(b) placing the encapsulated cell in a growth column;

(c) incubating the encapsulated cell in the growth column under conditions allowing the encapsulated cell to survive and be maintained,

(d) contacting a nucleic acid isolated or derived from the encapsulated cell with at least one nucleic acid probe comprising a detectable label, wherein the nucleic acid probe is capable of specifically hybridizing to a polynucleotide encoding an activity of interest; and

(e) detecting a specific hybridization between a nucleic acid isolated or derived from the encapsulated cell and the nucleic acid probe, thereby identifying a polynucleotide encoding an activity of interest.

38. The method of claim 37, further comprising enriching for a polynucleotide encoding an activity of interest by isolating or amplifying the nucleic acid identified by the specific hybridization between the nucleic acid isolated or derived from the encapsulated cell and the nucleic acid probe.